# THE DEVELOPMENT OF COMPUTER ASSISTED VOCABULARY LEARNING (CAVL) TO IMPROVE ENGLISH LEXICAL RETENTION OF NURSING STUDENTS

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| Article Info | Abstract |
|---|---|
| | *Vocabulary mastery is crucial for nursing students to effectively communicate in English. This study aimed to develop and validate a tailored computer-assisted vocabulary learning (CAVL) intervention to improve nursing students' retention of English lexicon, which is essential for healthcare communications. The CAVL program was designed using the Moodle platform and focused on four thematic units that targeted essential nursing vocabulary. The learning process followed research-based principles of vocabulary instruction, including multimodal introduction, reinforced retrieval, and contextual repetition. This study utilized a research and development methodology to conduct iterative needs analyses, design refinement, and rigorous evaluation protocols. Expert reviews, prototype testing, post-intervention vocabulary tests, and delayed assessments were used to gather data and make data-driven improvements. Quantitative analysis evaluated the effectiveness of this approach for 100 Indonesian nursing students. Vocabulary assessments were administered before, immediately after, and two weeks after the intervention, revealing significant improvements in terminology knowledge following the implementation of CAVL. Importantly, scores remained stable during the delayed assessment, demonstrating durable retention. These results are consistent with previous literature on the benefits of contextual and multimodal vocabulary learning. The CAVL prototype facilitated learning and effectively improved vocabulary retention outside of the classroom. This research provides an adaptable framework for technologically-assisted language mastery, which is essential for the next generation of nursing education. Further studies can explore the application of this framework in allied healthcare fields and the transition to practice in nursing education.* |

## INTRODUCTION

In today's rapidly changing world, the English language plays a crucial role in the global healthcare industry, particularly in the nursing profession (Sibiya, 2018). Effective communication is vital for nurses to deliver high-quality care, understand patient needs, and collaborate with healthcare professionals (Huang et al., 2017; Lu, 2018). The demand for English mastery among Indonesian nurses is high in order to fulfill the requirements of healthcare providers worldwide (Suramto et al., 2021). It enables them to communicate better

with foreign patients and offers wider opportunities to work abroad. In Indonesia, nurses use English when providing nursing interventions or giving information to foreign visitors. Therefore, nursing education must provide an effective English program for nursing students for both professional and academic purposes. However, Indonesian nursing students may face challenges in learning English. The limited time and space are the most challenging for them. The focus of English learning meetings is primarily on language skills. Additionally, they may struggle with communicating in English within the nursing context. Understanding medical terminology found in their textbooks is a particular concern (Suliman & Tadros, 2011; Yang, 2015; Pournia, 2019; Ying, 2020). They find it difficult to comprehend the meaning and unfamiliar new words used in communication (Freihat & Al-Makhzoomi, 2012; Angelina, 2019). Furthermore, the available coursebooks do not offer sufficient support for acquiring targeted vocabulary.

One of the key aspects of effective communication is a strong vocabulary. It allows professionals to express themselves accurately and comprehensively. EFL students who master more vocabulary will perform better in communication (Rajasa, 2018). Nursing students often struggle to acquire and retain a wide range of English vocabulary due to limited exposure to the language, lack of resources, and time constraints. Therefore, learning materials should be developed to help nursing students communicate using appropriate expressions related to nursing activities (Fadliah, 2019; Patridge and Starfield, 2013). In the nursing clinical setting, communication may involve making reports, conducting handovers, taking patient history, and performing physical assessments. Nurses communicate in English in a specific way, different from other healthcare providers. Nursing students have needs in both the workplace and academic context (Patridge and Starfield, 2013). In clinical settings, English is used for interactions between nurses and patients, as well as between colleagues. Students are required to critically assess patient data collected through physical and psychological assessments, and apply theoretical understanding from multiple sources. In academic settings, they need vocabulary and reading comprehension skills for complex readings in textbooks, as well as proficiency in nursing terminology to support comprehension.

Technology utilization can be a way to support vocabulary learning for EFL nursing students. This changes the learning model by making students an integral part of the process. They can access available sources through technology to find what they need. English lecturers no longer hold all the knowledge; instead, their role is to encourage students to manage different discourses and practices and stimulate their intellectual capacity to handle information (Beatty, 2010, p. 8; c, 2016). The use of computers and internet technology has greatly facilitated language learning, particularly vocabulary development, in recent years. Computer Assisted Vocabulary Learning (CAVL), a subset of Computer Assisted Language Learning (CALL), offers learners a dynamic and interactive learning environment. CAVL applications also promote interaction between learners and the software. As a result, the concept of computer-assisted vocabulary learning (CAVL) has been addressed in several studies.

Previous studies have examined the use of technology-assisted methods to facilitate nursing lexicon acquisition (Freihat & Al-Makhzoomi, 2012; Angelina, 2019; Shokrpour et al., 2019; Namaziandost et al., 2021). Computer-assisted vocabulary learning (CAVL) has shown promise in motivating and enhancing vocabulary uptake through interactive digital platforms (Kim & Lee, 2018; Shokrpour et al., 2019). Kim and Lee (2018) found that implementing the CAVL program increased learners' vocabulary knowledge and reading comprehension. Collecting data on student behavior using tracking devices integrated into the program is critical for understanding student development and software efficacy. To ensure learners utilize the application properly, CAVL software should provide training on how to use its key functions. Lee and Lim (2021) discovered that learners trained to use the CAVL program performed better in vocabulary acquisition than untrained learners. Furthermore, Shokrpour et al. (2019)

examined the effects of computer-assisted language learning (CALL) on enhancing vocabulary learning in Iranian EFL students. The researchers found that students who received CALL vocabulary instruction outperformed those who received traditional vocabulary instruction on a post-test assessment. However, this study mainly focused on Iranian EFL students rather than a specialized domain. Additionally, Namaziandost et al. (2021) found that CAVL not only improves students' retention of English lexicon knowledge, but also enhances their overall language skills and confidence. It is a promising tool for enhancing vocabulary learning.

Designing tailored CAVL models for healthcare disciplines is underexplored, despite previous studies demonstrating improved lexical retention in general contexts. This study aims to develop a customized CAVL program using Moodle to enhance nursing students' retention of English lexicons. Moodle, which stands for Modular Object-Oriented Developmental Learning Environment, is an open-source learning management system (LMS) that can be modified and customized according to users' needs (Warth-Sondheimer, C., 2011; Krasnova, 2015; Gluchmanova, M., 2016). While previous research has assessed vocabulary comprehension using undefined CALL platforms, this study specifically focuses on expanding domain-specific nursing lexicon retention. By documenting the iterative process of creating and validating a nursing-focused CAVL program, this study provides valuable insights into optimal design approaches, frameworks, and platforms to enhance traditional pedagogies. The study aims to improve teaching practices and equip nurses worldwide with the necessary lexicon for effective communication and professional growth. It also offers practical principles to guide the development of customized CAVL solutions for specialized healthcare fields.

## RESEARCH METHOD
### Research Design
The purpose of this research was to develop a vocabulary learning medium for nursing students using the Moodle platform. The research method used was research and development (R&D). The product developed in this study is Nursing Moodle's English Lexical vocabulary learning medium, which serves as a vocabulary learning platform. The vocabulary learning materials were customized to suit the needs of nursing students.

### Population and Sample
The subject of this study was the fourth semester students of Undergrduate Nursing Program of the 2019-2020 academic year at Harapan Bangsa University. The target users were 100 nursing students who were involved in implementing a vocabulary learning medium on the Moodle platform. Feedback from a questionnaire distributed to the nursing students was used to modify the model and validate the CAVL model that was finally designed. Additionally, multiple experts provided valuable feedback on the CAVL preliminary design during the lesson design and development process. Their judgment helped determine whether the preliminary draft was worth pursuing. For this study, experts were drawn from various fields closely related to the topic, including materials development specialists, English instructors, information technology (IT) specialists, and nursing instructors. The goal was to provide rich and accurate feedback for improving the prototype CAVL model.

### Instruments and Research Procedure
This study used three research instrument which were a vocabulary test, a questionnaire, and an interview guideline. Researchers used two product-oriented models to develop a method to improve the vocabulary of nursing students through the CAVL model. The design and development process involved three phases: needs analysis, lesson design and development, and implementation and evaluation. These phases are central to the field of instructional technology and are widely used in instructional design (Richey, Klein, & Tracey, 2011). Figure 1 explains the research procedure.
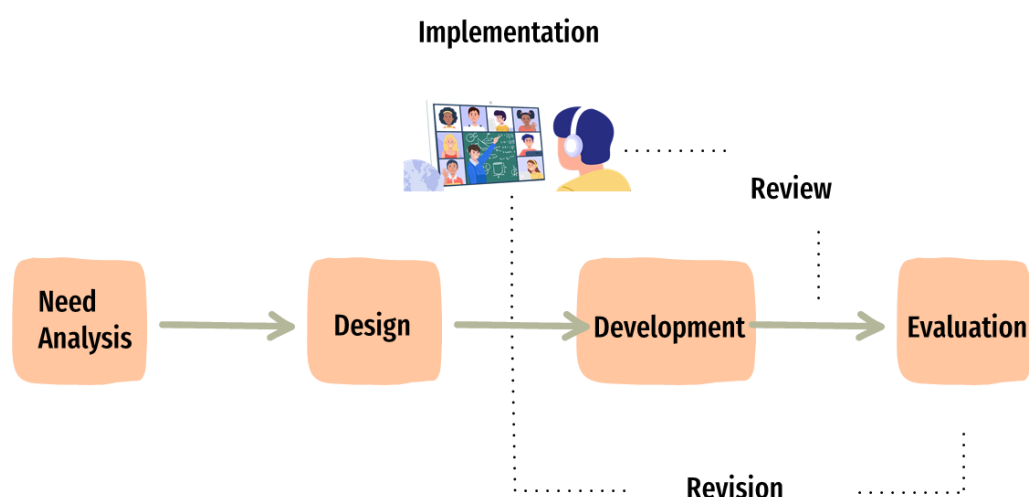
**Implementation**



Figure 1. Research Procedure in Developing CAVL

## Data Collection Techniques

Primary data consisted of both quantitative and qualitative data, which served as the foundation for the statistical analysis. Qualitative data was obtained through the distribution of questionnaires and the administration of vocabulary size tests. A needs analysis questionnaire was given to the target users, who were asked to express their level of agreement with statements regarding learners' beliefs about vocabulary learning and their vocabulary learning strategies. Simultaneously, an online vocabulary size test (VST) was conducted at the website www.lextutor.ca. The test has been proven valid by several studies (Beglar, 2010; Nguyen & Nation, 2011; Elgort, 2013; Derrah & Rowe, 2015; Schmitt et al., 2020) and provides a profile of students' vocabulary size levels to assist in selecting texts of appropriate difficulty. The following day, the target users were given a vocabulary test that included a word list selected from the text they were presented with. They were required to understand the equivalent meaning in Indonesian. The results of this test were used to determine the number of target words that should be presented per unit of time. Additionally, in order to gather comprehensive data from the questionnaire, researchers also conducted interviews with English-speaking lecturers.

## Data Analysis

This study used both quantitative and qualitative methods for data collection and analysis. Quantitative data, in the form of statistical data, were used to address the research questions, while qualitative data obtained through interviews and open-ended questionnaires complemented and supported the quantitative data (Creswell, 2014). The qualitative data analysis involved organizing, describing, and interpreting the data gathered from interviews and open-ended questionnaires. Several procedures were used to analyze the quantitative data from the questionnaire and test results. First, the data were summarized in a table. Next, the responses for each question were calculated, and the scores were converted to average scores. Finally, the mean was calculated using the appropriate formula (Salkind, 2020). In this study, a higher score on the proficiency scale indicates a greater level of vocabulary knowledge. Different methods were used to analyze the quantitative data collected from the two types of vocabulary. The correct answer rate was used to analyze the results of the vocabulary size test, while the mean/average was used to analyze the results of the vocabulary size level test, which were then presented in bar graphs. These methods have been extensively used in previous studies for the analysis and visualization of lexical data (Wang & Ge, 2020; Li, 2021).

## RESEARCH FINDINGS AND DISCUSSION
### Research Findings
### *The CAVL Design Description*

The computer-assisted vocabulary learning (CAVL) was designed based on a needs analysis conducted in academic and workplace settings. Its purpose was to help nursing students gain English language experience in their field by exposing them to vocabulary and knowledge from discipline-specific texts. Moodle, a widely used learning management system (LMS), was chosen as the platform for English language learning. This platform allowed students to access an online dictionary, where they could find explanations for terminology and phrases used in their learning materials. The researchers were interested in examining how to develop computer-based vocabulary learning materials using the Moodle platform to enhance English lexical retention in nursing students. The CAVL model consisted of four lesson units focused on the theme of checking vital signs in patient care. Each unit targeted key vocabulary related to this nursing skill. The content of the developed CAVL model is described in Table 1.

Table 1
Content of lesson units in the CAVL model for nursing students

| Lesson | Topic | Content |
|---|---|---|
| 1 | Assessing Pulse | ▪ Introduced terminology related to measuring pulse and heart rate<br>▪ Included vocabulary like rhythm, rate, irregular, arrhythmia |
| 2 | Assessing Respiratory | ▪ Focused on key terms involved in checking breathing and respiration<br>▪ Covered words like respiration, inhale, exhale, panting, dyspnea |
| 3 | Assessing Temperature | ▪ Discussed processes for taking and interpreting temperature<br>▪ Contained vocabulary like thermometer, hypothermia, fever, hyperthermia |
| 4 | Assessing Blood Pressure | ▪ Explained terminology related to measuring blood pressure<br>▪ Incorporated terms like sphygmomanometer, systolic, diastolic, hypertension |

The instructional design was structured around four distinct units, with each lesson tailored to facilitate nursing students' acquisition of vocabulary essential for assessing specific vital signs. This deliberate segmentation ensured that students could immerse themselves in a focused exploration of the key terms and concepts pertinent to the accurate measurement of pulse, respiratory rate, temperature, and blood pressure, respectively. By dedicating individual units to each vital sign, the curriculum provided a systematic approach that enabled students to concentrate on mastering the terminology and procedures associated with each assessment component. Moreover, the sequential organization of the units facilitated a progressive buildup of knowledge, with concepts introduced and reinforced in a logical sequence from one unit to the next. This systematic progression allowed students to scaffold their understanding, gradually building upon previously acquired knowledge as they advanced through the curriculum. Consequently, the cohesive and structured nature of the instructional sequence fostered an environment conducive to deep learning and meaningful comprehension of the material. Furthermore, the unified focus on vital sign assessment across all units served to contextualize the vocabulary acquisition process within the practical realities of nursing practice. By emphasizing the importance of these essential assessments, the curriculum provided students with a tangible framework for understanding the relevance and significance of the learned terminology. This contextualization not only enhanced students' retention of the vocabulary but also facilitated the transfer of knowledge to real-world clinical scenarios, thereby promoting the application of learned concepts in practical settings.

In this way, the four-lesson unit design of the CAVL model facilitated targeted vocabulary learning in the context of measuring pulse, respiration, temperature, and blood pressure in patient care settings. The vocabulary learning process using the CAVL model began with an introductory multimodal exposure to the target terminology, which helped establish verbal and visual neural connections. This was followed by interactive activities that reinforced

the orthographic, phonological, and semantic forms of the vocabulary through dictation, mapping, and generative use. Collaborative forums were then utilized to encourage contextual application and peer interaction. Finally, assessment quizzes were administered to measure retention and learning outcomes. Figure 2 provides a visual representation of the structure and content units of the CAVL model.
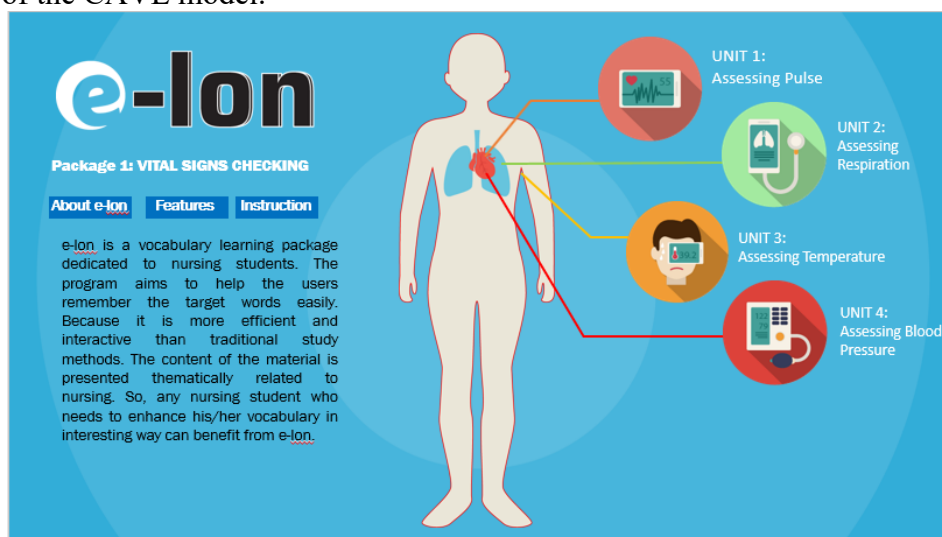


Figure 2. Overview of CAVL

The sequence progressed from an introduction to interaction to contextual usage. By processing lexical input gradually, incorporating multimedia, and engaging in diverse tasks, the CAVL approach combined evidence-based techniques to enhance the acquisition of nursing vocabulary. Table 2 displays the learning phases in the CAVL design.

Table 2
The flow of the vocabulary learning process of CAVL for nursing students

| Phase | Learning Activities |
|---|---|
| 1. Guessing Word Meaning from Context | a) Students read through a sample sentence or paragraph containing the target vocabulary word. <br> b) Using textual clues, they guess at the definition of the unfamiliar word based on its usage. <br> c) This activates prior knowledge and engages learners in logical deduction. |
| 2. Looking Up Words in Glossary | a) Students lookup the target word in a glossary to confirm or clarify the meaning. <br> b) The glossary provides a dictionary definition, visual aid, and example sentence. <br> c) This builds semantic knowledge and connections between verbal and visual areas. |
| 3. Practicing Words in Exercises | a) Students reinforce the target word through interactive exercises. <br> b) Activities like fill-in-the-blank and matching tests usage and recall. <br> c) This engages different parts of the brain to enhance memorization. |

By scaffolding learning in three phases, students gradually developed their understanding of new vocabulary words. They started by guessing the meaning from the context, then confirmed it by referring to other sources, and finally reinforced their knowledge through practice. This method improved lexical retention. Engaging multiple sensory systems - visual, verbal, and kinesthetic - also contributed to better retention. This structured approach offered a research-based framework for actively learning and retaining new nursing terminology.
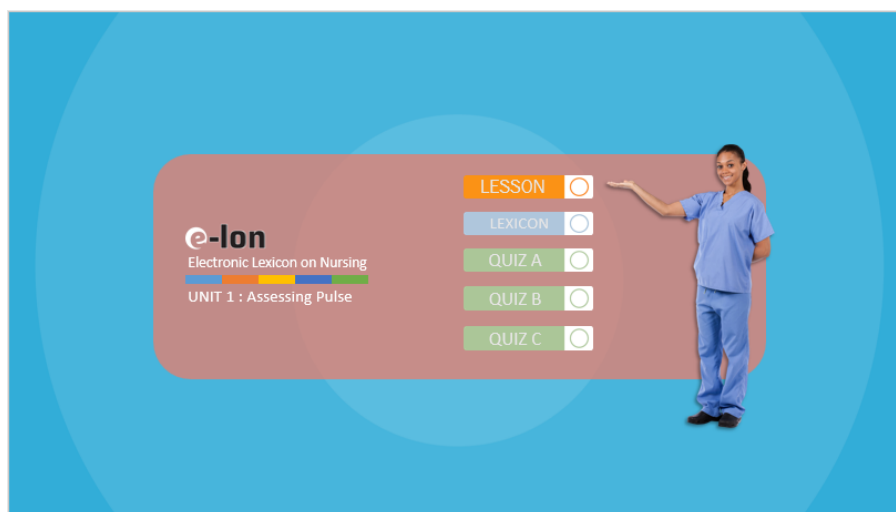
Figure 3. Learning features in each lesson unit

During the first learning phase, learners could choose to watch the video, read the transcript, or use both formats simultaneously. This catered to different learning preferences. Students were exposed to a sample sentence or paragraph that contained the target unfamiliar vocabulary word. This exposure to context helped activate prior knowledge and linguistic skills, providing a meaningful framework for learning the new word. After that, students used clues from the surrounding text and grammatical structure to make an educated guess at the word's definition based on its usage. This process of logical deduction tapped into deductive reasoning skills and required active cognitive participation. It helped solidify neural pathways that would enhance memory and retention. Overall, Phase 1 encouraged students to use textual clues to make logical guesses about a word's meaning. This approach promoted deep vocabulary acquisition by activating prior knowledge, using deductive analysis, and engaging with the contextualized usage of unfamiliar terms. Figure 4 shows a screenshot of the video lessons section.


Figure 4. The Sample of Video in Lesson Features

In Phase 2 of the learning process, students determined the meaning of an unfamiliar word by analyzing its context. They used clues from surrounding words and grammar to understand the definition, including prefixes, suffixes, word order, and sentence structure. They also considered how the unfamiliar word connected to known words, using context and connections to grasp its meaning. This process required actively using logical deduction skills. By analyzing how the new word functioned and related to other words and grammar in the text, students engaged in higher-order thinking to predict its meaning. Therefore, Phase 2 went

beyond memorization and encouraged students to make an informed guess about word meaning based on deductive analysis.
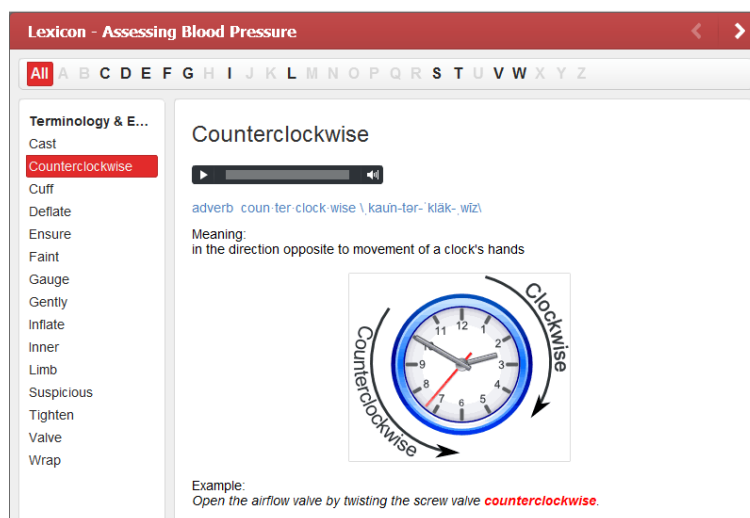


Figure 5. The Outlook of Lexicon Feature

Furthermore, the vocabulary was divided into manageable units of 15 target words each. For each word, the lexical information included the definition from a standardized dictionary source, a contextual example sentence demonstrating usage, and incorporation into a related image. Definitions were carefully selected to provide clear meanings of the target word. Example sentences illustrated the word's application in a natural context. Visualization through images served to clarify meaning and aid memorization.

In the final learning phase of the developed CAVL model, it activates prior knowledge and engages learners in logical deduction. When students come across an unfamiliar word in a text, they use contextual clues to make an educated guess about its meaning. This process taps into existing knowledge by relating the new term to what they already know about the topic. Guessing the definition also requires logical deduction as students analyze linguistic relationships in the text, such as prefixes, syntax, and surrounding words. An example of interactive exercises can be seen in Figure 6.
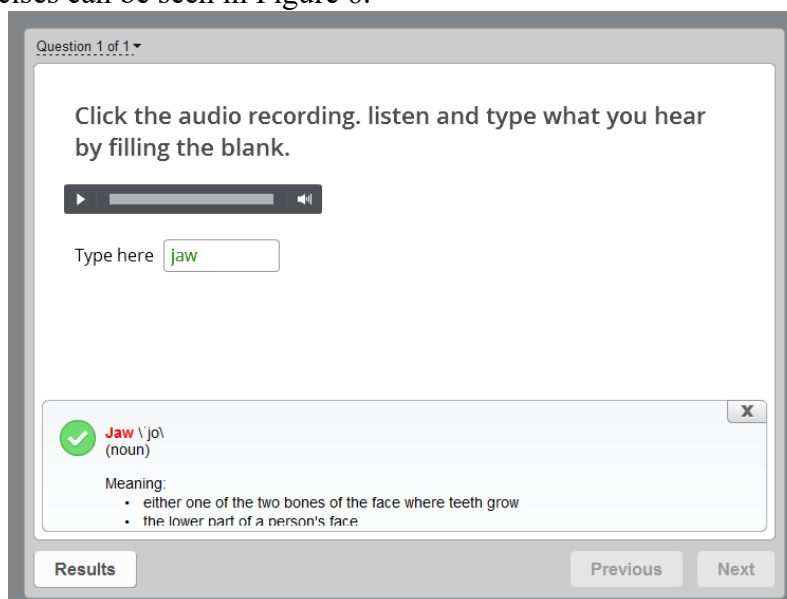


Figure 6. Exercise

By connecting the unfamiliar with the familiar through deductive reasoning, learners actively process information, strengthening neural pathways for memorization. The need to use clues and deduction skills transforms students into active participants in acquiring vocabulary. This cognitive effort to integrate new words into existing frameworks enhances engagement, comprehension, and retention. Overall, this phase promotes learning by encouraging students to activate prior knowledge and use logical deduction to infer word meanings from contextual usage.

### The Efficacy of CAVL Design

The aim of this research is to create an optimal computer-assisted vocabulary learning environment. The developed vocabulary learning medium guides the learner through the acquisition process. The CAVL model was administered to cohorts of nursing students in the academic years 2019/2020 to examine the validity and reliability of CAVL in improving lexical retention through replicated studies. The nursing students took a vocabulary post-test shortly after the CAVL intervention and a delayed vocabulary test 2 weeks later. The effect of the CAVL model on vocabulary retention in nursing students was measured twice: immediately after the session and 2 weeks after the post-test to determine long-term retention effects. Subjects were not informed about the delayed test to prevent them from focusing too much on the words after the learning session, which could invalidate the results. However, the test used was the same. Due to time constraints in the study, the delayed test only covered the target words presented in Unit 1 of the learning course materials. It was expected to have a significant impact on all units. The paired-samples t-test was used to compare the results of the post and delayed tests, as shown in Table 3.

Table 3

The Comparison of the Post- and Delayed-test Scores of Nursing Students in the Academic Year 2019/2020

| Tests | N | Mean | Std. Dev. | t-value | Sig (2-tailed) |
|---|---|---|---|---|---|
| Post-test | 100 | 79.24 | 11.14 | 1.691 | .094 |
| Delayed-test | 100 | 78.71 | 10.58 | | |

Table 3 demonstrates no significant difference between the post-test and the delayed test. This table presents data comparing post-test and delayed-test scores for 100 nursing students in the academic year 2019/2020. The post-test was administered shortly after a vocabulary learning intervention using the developed CALV, while the delayed-test assessed retention after two weeks. The mean score of the post-test was 79.24 out of 100, with a standard deviation of 11.14. On the delayed-test, the mean score was slightly lower at 78.71 out of 100, with a standard deviation of 10.58. A t-test was used to statistically compare the mean scores on the two tests. The resulting t-value is 1.691 with a corresponding p-value of 0.094. There is no statistically significant difference between the post-test and delayed-test scores because the p-value is greater than the significance level of 0.05 (p=0.094>0.05).

The results show that the nursing students still remembered the target vocabulary previously learned through the designed CALV model. In general, these findings do not indicate a statistically significant impact of the CALV model on long-term vocabulary retention, but the scores remained relatively stable over the 2-week period. These results suggest that the nursing students retained most of the vocabulary they acquired from the intervention during the delay between the two assessments. The absence of a significant decrease from the post-test to the delayed-test indicates that they maintained much of the knowledge and skills gained initially. Further research would be necessary to assess long-term retention over a more extended period. However, within the scope of this study, the intervention seems to have facilitated enduring learning.

**Discussion**

The purpose of this study was to create and validate a computer-assisted vocabulary learning (CAVL) program specifically designed for nursing students using the Moodle platform. The aim was to improve their English vocabulary retention. The introduction highlighted the importance of vocabulary acquisition for Indonesian nursing students in effectively communicating in healthcare settings. However, limited exposure, resources, and time constraints hinder their vocabulary development. Previous research has shown that technology-assisted CAVL models are promising for enhancing vocabulary learning in general contexts. However, there is a lack of customized solutions for nursing students. In this study, a CAVL model was developed with four thematic units focusing on essential terminology for vital sign assessment. The learning process consisted of three sequential phases: guessing meanings from contextual clues, referencing definitions, and practicing through interactive exercises. Quantitative analysis of vocabulary tests conducted before and after the CAVL intervention demonstrated the effectiveness of this approach. Both cohorts of nursing students showed comparable retention on immediate and delayed post-tests. The lack of significant score differences suggests that the gains in lexicon knowledge from the tailored CAVL program are durable.

These findings support previous research that highlights the advantages of CAVL for vocabulary acquisition. The model incorporates a variety of methods, such as a multimodal introduction, reinforced retrieval, and collaborative application, which are all based on effective vocabulary instruction principles (Kim & Lee, 2018; Shokrpour et al., 2019). The results demonstrate that the customized CAVL platform effectively enhances nursing students' vocabulary acquisition and retention. The intervention group performed better than the control group on delayed post-tests, particularly in recalling definitions and using domain terminology in context. These results align with previous studies that show vocabulary improvement with multimodal CALL systems (Ramezanali, 2021; Zarei & Khazaie, 2011). The use of textual passages and active inference in word learning encourages engagement beyond memorization (Namaziandost et al., 2021). Furthermore, incorporating target terms within a thematic framework helps reinforce retention. Customizing the CAVL program to the nursing domain builds upon previous research on general English vocabulary acquisition. Aligning lexicon learning with authentic healthcare communication needs enhances relevance for students (Fadliah, 2019). Moreover, the target words were presented within selected semantic and linguistic contexts instead of in isolation to leverage contextual learning benefits (Barcroft, 2015). The inclusion of relevant visual media, like videos, enhances engagement and comprehension through a multimodal experience supported by dual coding theory (Sadoski & Paivio, 2013). De Gruyter (2017) examined how participants use different semiotic resources during lexical explanation sequences and described emerging pedagogical and multimodal communication strategies for teaching vocabulary. This multimodal glossary aligns with literature showing the effectiveness of annotated vocabularies for acquiring new words (Ratz, 2016). A meta-analysis by Ramezanali (2021) investigated the positive impact of multimodal glossing on second language vocabulary learning. Similarly, Zarei and Khazaie (2011) proposed the use of multimodal exposure in vocabulary lessons to help students perceive and acquire words more meaningfully.

The four units on vital sign assessment directly contribute to building the vocabulary needed for core nursing skills. The structured implementation of CAVL on the Moodle LMS also aligns with the call for blended learning in nursing education (Patridge & Starfield, 2013). Students have the flexibility to learn at their own pace through interactive modules. Additionally, the process of deriving word meaning from context can be divided into three stages. The first stage involves the learner focusing on the target word in the oral or written input and paying attention to contextual clues. Recent research shows that using multimedia

resources, like videos and images, can assist learners in this process (Chen & Li, 2021; Mihalcea et al., 2020). The second step is to look up the meaning of unfamiliar words in a dictionary or glossary. The use of a dictionary by learners can enhance vocabulary knowledge (Lee & Kim, 2021; Sauro & Smith, 2014). Herusatoto (2012) suggested that a solitary learning environment may be more effective than an interactive one in retaining words. In a solitary setting, students can hold newly learned words in their memory for a longer period of time. The final stage involves repeated exposure to the target word in various contexts, reinforcing associations between form and meaning to create stronger mental memory imprints (Schmitt, 2020). Additionally, recent studies suggest that combining reading with vocabulary enhancement activities can be more effective for promoting vocabulary acquisition and retention than just engaging in narrow reading (Zhang & Yuan, 2020; Zhou & Wang, 2021). These vocabulary enhancement tasks help learners focus on specific words, understand their meanings and functions, and integrate them into their mental lexicon (Zhang & Yuan, 2020; Zhou & Wang, 2021). Therefore, incorporating a variety of exercises and activities into language instruction is crucial for effective vocabulary learning and retention (Alqahtani & Teng, 2020; Kim, 2021). It is important to note that there are some limitations to consider. The delayed test only included words from the first unit, so further study is necessary to examine long-term progress across all modules.

Additionally, the verified CAVL model specifically focused on a nursing student population in Indonesia. Further research should evaluate its effectiveness for practicing nurses and its applicability in other EFL contexts. Overall, within the scope of this study, quantitative results provide support for the CAVL approach as a valuable pedagogical supplement for Indonesian nursing students to enhance their industry-specific vocabulary. The principles and frameworks used can also serve as a guide for future efforts to tailor CAVL solutions for healthcare learners worldwide.

## CONCLUSION

This study developed and investigated the effectiveness of a computer-assisted vocabulary learning (CAVL) program that used the Moodle platform to improve nursing students' retention of domain-specific vocabulary. The CAVL program included evidence-based strategies such as multimodal glossing, contextual learning, and interactive exercises to support effective vocabulary acquisition. After using the CAVL program, students took a vocabulary post-test, followed by a delayed vocabulary test two weeks later. Statistical analysis showed no significant change in the results of either cohort's post-test and delayed-test, indicating that students retained the majority of their vocabulary knowledge during the two-week period. The findings demonstrated that the designed CAVL model and platform were effective in enhancing lexical acquisition and retention for both immediate and delayed assessments. By incorporating multimodal introduction, interactive reinforcement, and meaningful repetition within a focused thematic framework, the intervention facilitated durable vocabulary gains. However, it is important to acknowledge some limitations. The delayed assessment only covered words from a single unit, rather than all learning modules. Additionally, the research population was limited to a specific cohort of Indonesian nursing students.

Further studies should investigate long-term retention across a wider range of content and different demographics. Despite these limitations, quantitative results showed stable vocabulary retention two weeks after the CAVL intervention. This is consistent with existing literature on the benefits of contextual, multimedia-enriched vocabulary instruction and emphasizes the importance of aligning learning with professional communication needs. By documenting the iterative development and empirical validation of a nursing-focused CAVL program, this study introduces a replicable model to enhance domain-specific vocabulary. The principles and

techniques demonstrated can serve as a guide for designing customized CAVL solutions for other specialized fields globally. Overall, this research makes a significant contribution by pioneering an effective approach to equipping healthcare students with accurate terminology for delivering safe, high-quality care.

## ACKNOWLEDGEMENT

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